

A. E. Sones

City of Leeds Training College

Biology (Zoology)

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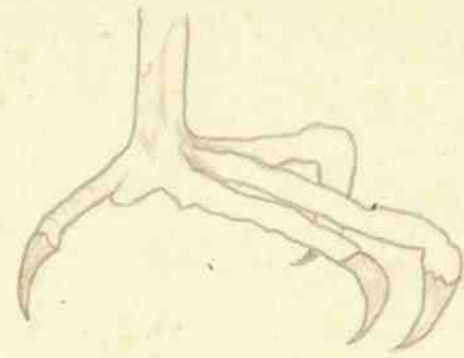
Leighton Hall.

Biology I: (Animal Life - Zoology)

BIOLOGY. BIRDS - ANIMALS.

Neck of bird - prehensile

KESTREL.

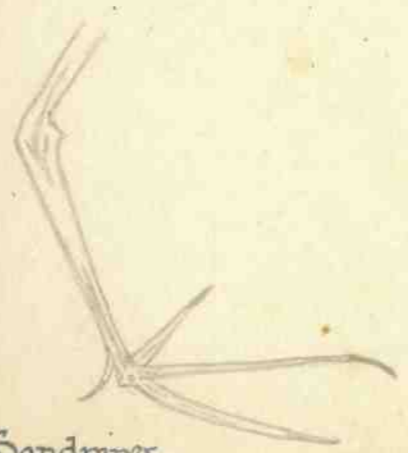


Claw of Kestrel.

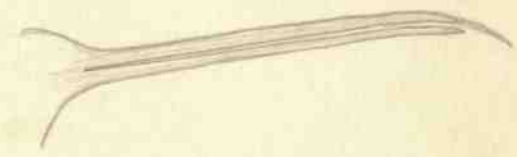


Beak of Kestrel.

Sandpiper.



Claw of Sandpiper.

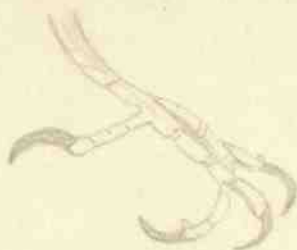


Beak of Sandpiper.

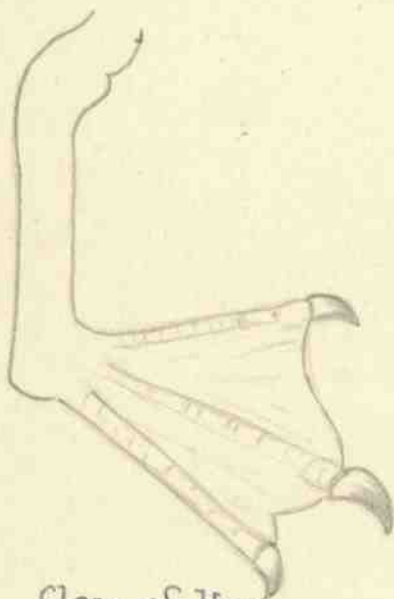
SPARROW



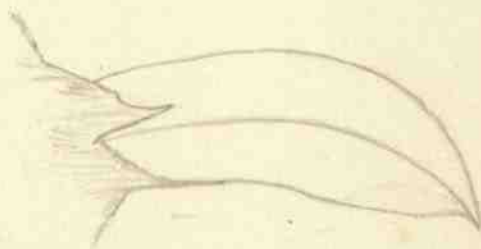
Beak of Sparrow



Tarsus of Sparrow



Tarsus of Heron



Beak of Heron

# FEATHERS.

- I Those id: give outline to body - Contour feathers or penna  
- wing - tail - head - neck - breast.
- II Down feather or plumule - young birds - eider ducks.  
- other feathers cover down - eider ducks retain down all their lives.
- III Filoplume - hairlike

## Analysis of Contour Feather structure

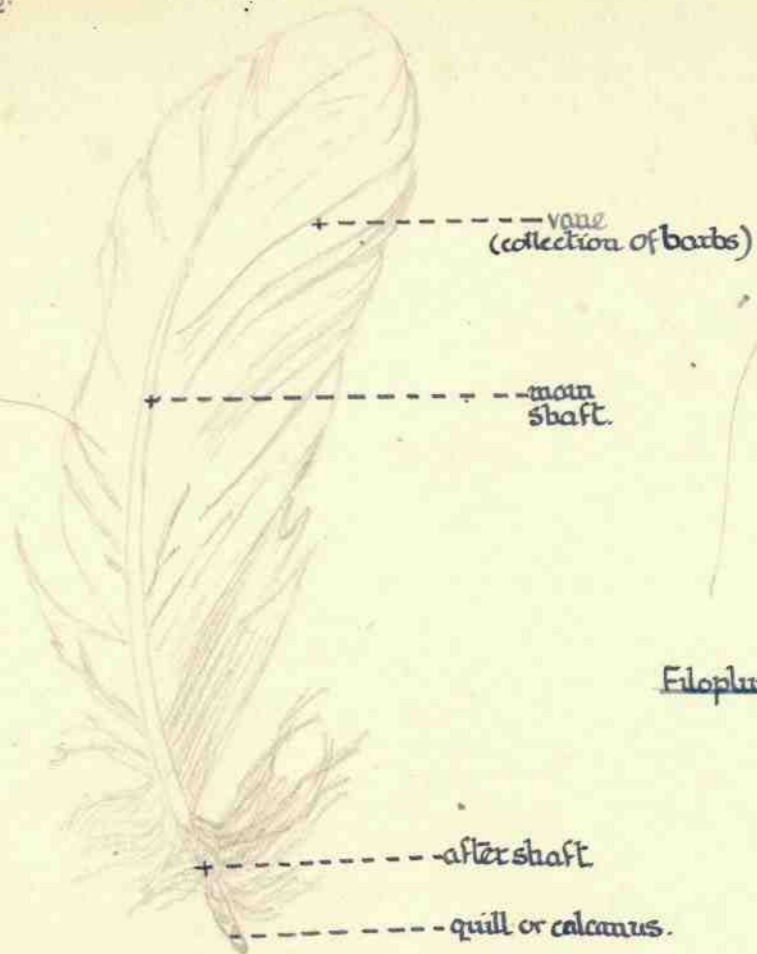
- 1 Quill or Calamus - leads up to
- 2 Main shaft or rachis - filled with pith - furrow on under side
- 3 Vane - on sides of main shaft - elastic - airtight - can be moulded
- 4 Barbs - constitute vane.
- 5 After shaft - short fluffy part at side of quill.

Barbs so tightly interwoven by barbules that no air can pass through it unless barbs forced apart.

## N.B. Biological terms

Anterior	Dorsal surface	Proximal (fixed end of limb)
Posterior	Ventral surface	
lateral	Distal (loose end of limb)	

# FEATHERS.

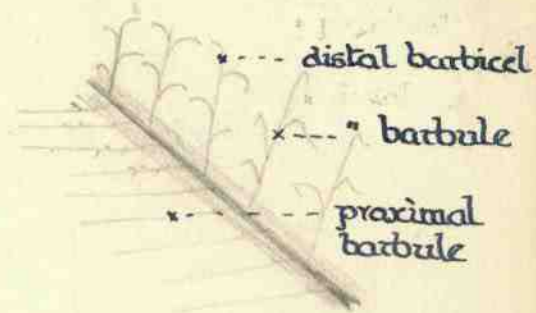


Contour Feather.

Down Feather.

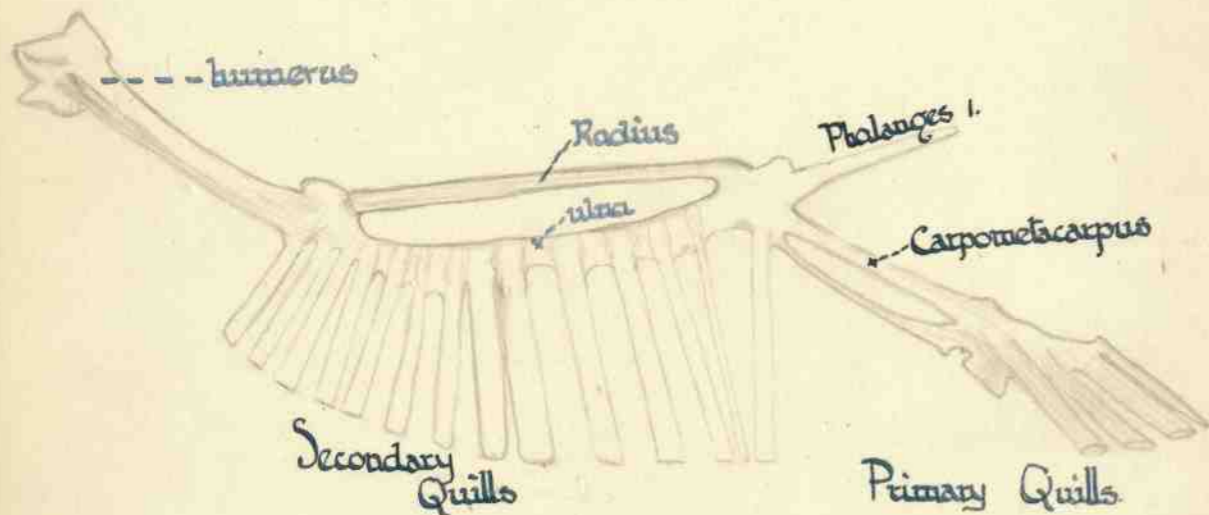
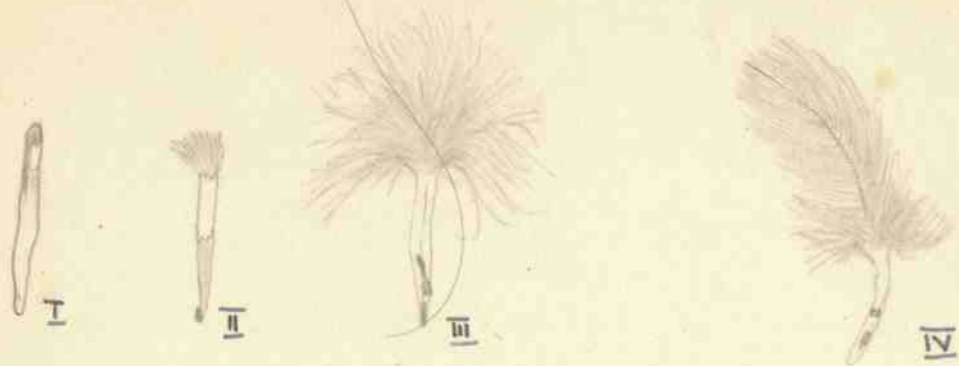


Grouse Feather.



Microscopic View of portion of barb.

## DEVELOPMENT OF FEATHERS



## DEVELOPMENT OF FEATHERS

Grown from follicle at base of pit in skin.

### USE OF FEATHERS

1. Serve to retain heat
2. Render flight possible

### COLOUR & MARKINGS

Render birds either inconspicuous or conspicuous.  
Young that are hatched on ground show protective resemblance to background - are speckled.  
Males brighter marked than female - especially at mating time - peacocks - ruff - lowest pheasant.

### Colour obtained

- I Pigment reflects colour.
- II Rainbow - this happens in many feathers

Birds molt once per year - wing feathers come off in pairs from sides etc: to keep proportion.  
Wild duck male molts 2 per year - summer eclipse plumage - brilliant plumage in winter.

## WINGS

Feathers primary & secondary - feathers flap over - called coverts - tufts called scapulars

## Birds.

### Flight

1. Wings fold in one plane only - like pen knife
2. Down stroke body raised  $\therefore$  greater muscle  
up stroke body falls - smaller muscle.  
Amount of fall dep. on wt of body & speed of force
3. lower side concave upper side convex.

### Value of feathers

1. Offer a large surface to the air
2. They are light
3. elastic - not easily broken
4. Replaced annually

### 4. Hollow bones

Remarkable - length of flight - overseas journeys  
golden plover - from Alaska to Brazil & another journey  
over sea from Newfoundland 2,500 mls.

### Migration of Birds.

migratory birds breed in northernmost part of its territory  
Winter visitors of England - fieldfare  
swallows fly south.

#### Resident

Breed in Britain

House Sparrow.

Starling.

Owl.

Lark.

Thrush.

Yellow Ammer.

Chaffinch.

Maggie.

Rook.

Pewit.

Blue Tit.

Wren.

Robin.

#### Summer Visitors

Breed in Britain

Swallow.

Cuckoo.

Nightingale.

Redstart.

Corncrake.

Willow Warbler.

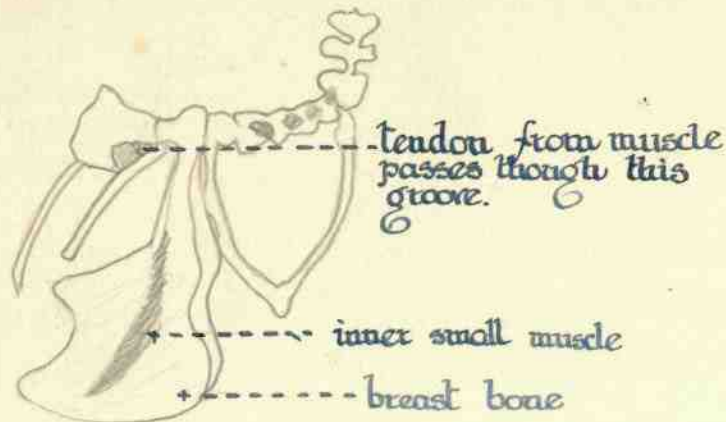
#### Winter Visitors

Do not breed in Britain.

Fieldfare.

Redwing.

Brambling.

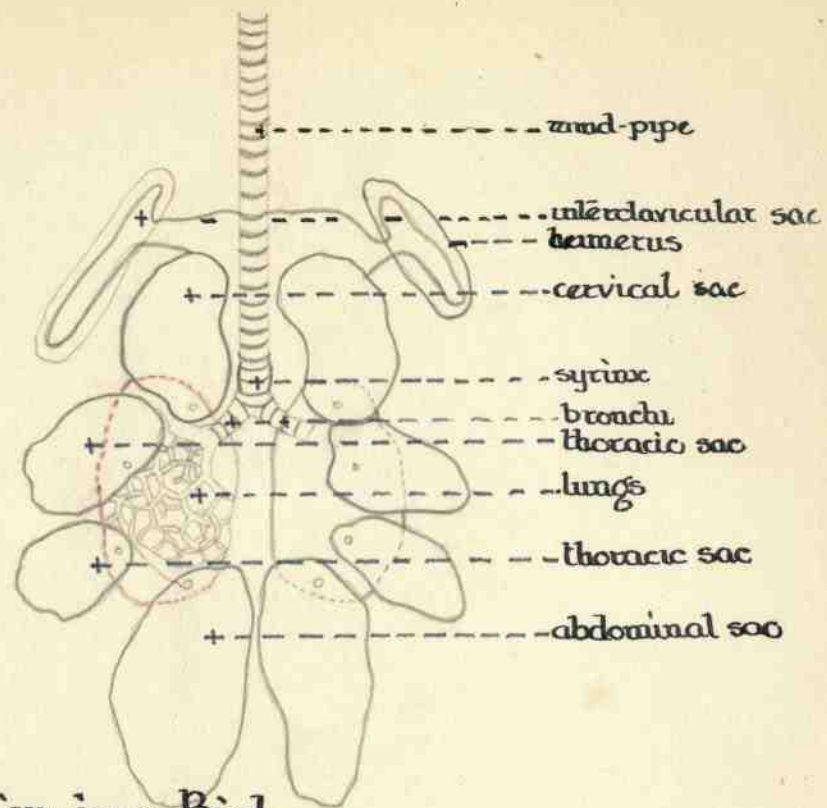


### Why Birds Migrate.

#### Suggestions

1. Temperature - driven away by cold & intense heat
2. Food - breed where most food for young
3. Homing Instinct - if migratory bird in cage - at migrating time it gets restless & dies.

Jan 10<sup>5</sup>



## Organs of Respiration in a Bird

## Organs of Respiration

Air enters nostrils & passes into mouth - glottis - trachea or wind pipe (ringed) - syrinx - bronchi (divides into bronchioles tubes).  
Abdominal muscles contract & expand.  
Great effort to drive out air than to take in - chief breathing by abdominal intercostal muscles.

When standing bird breathes by elevation & depression of sternum produced partly by abdominal & partly by intercostal muscles.

When flying sternum is immovable as wt is supported by wings & elevation & depression of back has same effect.

Bird lungs - air into air sacs - no residual air - air goes straight through lungs.  
Special adaptations for breathing.

- ① lungs - relatively small - large surface for gaseous exchange
- ② Air sacs are greatly developed
- ③ lungs fixed to ribs wh. help in respiration

## Organs of Digestion

Food taken in by mouth - no teeth. - tongue used to help swallow - food passes down pharynx wh. is made up of gullet - crop - gullet.

Stomach - made up of proventriculus & the gizzard.

Proventriculus - glandular - gastric juices.

Intestines - duodenum (U-tube) pancreas - ileum - rectum - cloaca (waste products & eggs.) - Anus.

Liver - secretes bile - into duodenum.

Mouth - salivary glands - saliva mixed with food - starch to sugar. - not necessary in birds -  
Crop - no digestion - storage function. - milky feed with solid particles is produced - pigeons milk + not really milk - for feeding young.



Stomach - in carnivorous birds There are gastric glands

Gizzard does not develop.

Ferrying-gulls - stomach changes 2 per yr. - grains & fish diet

Gizzard - food ground & passed on to duodenum

Chyme - acted upon by Pancreatic fluid - enzymes

- ① Changes starchy food to sugar
- ② Changes proteins to peptides
- ③ Emulsifies fats & changes it into fatty acids & glycerol.

Chyme becomes Chyle after being acted upon by Pancreatic fluid

Liver - largest organ in the body.

Blood from intestinal region straight into liver.

Peptides out of blood by absorption & stored as

Glycogen in liver

When body at rest it reverts glycogen into starch sugar to keep body alive

Glycogen - reserve food for muscles.

This removal of sugar prevents blood from being overcharged

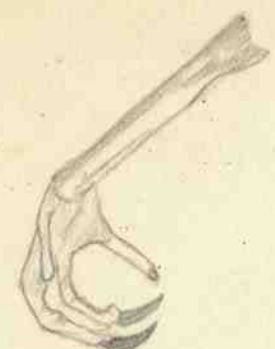
Produces bile.

Bile - waste product - antiseptic - emulsifies fats - eliminates some of waste nitrogenous products.

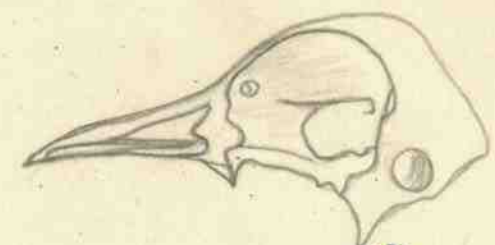
Gall-bladder - disappears in adult bird

present in young bird

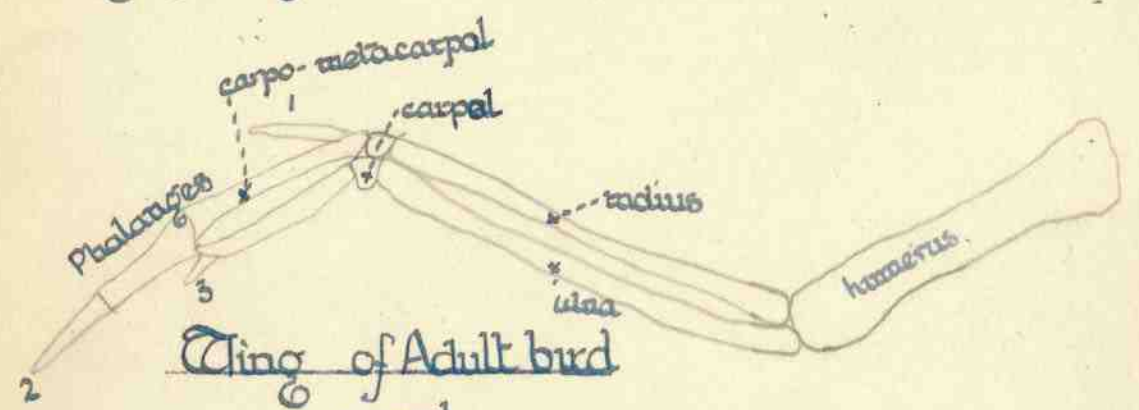
# SKELETON OF PIGEON



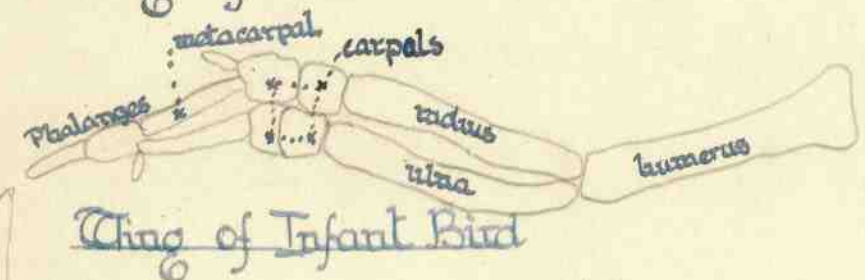
Leg of Pigeon



Skull of Pigeon



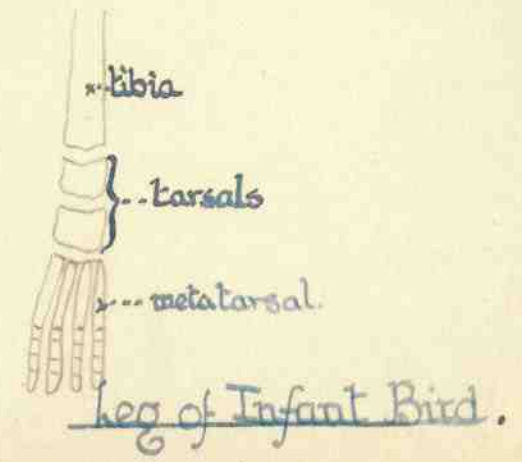
Wing of Adult bird



Wing of Infant Bird



Leg of Adult Bird



Leg of Infant Bird.

## Adaptation of Bird for Flight

Hollow bones - indication of fusion of bones.  
 Fusion because over flexibility might mean dislocation  
 - the only skeleton in which there is the fusion.  
 Carpo metacarpals tarso metatarsals peculiar to birds.

Thoracic vertebrae are all fused :: wing attached to solid structure.  
 Modification of keel  
 Ribs - basket-like structure - elastic

Bones at top of legs are fused into solid mass  
 - light - good attachment for legs.

Skull - bones fused together - lower jaw easily opens wide - eyes v. large - brain abnormally small - only one knob for pivot on top of vertebrae.

Wings fold in 1 plane only - strong muscle for down stroke - feathers - hold air.

## Circulation Blood.

Liquid containing corpuscles - <sup>eleptide</sup> biconvex corpuscles  
In red corpuscles there is a nucleus - in birds but not in mammals.

Pigeon 4,000,000

Man ♂ 5,000,000

♀ 4,500,000

White corpuscles - leucocytes. Pigeon 15,000 - 30,000  
Man 6,000 - 8,000

Serum - similar composition to sea-water

Contains salts also products of digestion nitrogenous waste  
Products of ductless glands into serum.

Endocrine

or  
Ductless Glands

Pituitary glands - These stimulate or retard growth as gland's size varies

Thyroid gland - pours substance containing iodine into blood

## Blood as a gas carrier

Oxygen - Carbon dioxide - nitrogen

Water dissolves air - if water could not dissolve oxygen there would be no life at all.

More pressure on surface the more gas is dissolved in the water.

800 ccs water at 10.5° C gives off 29 cc gas  
26 cc gas to a litre.

Richer in oxygen than air.

Blood dissolves gases more quickly than water

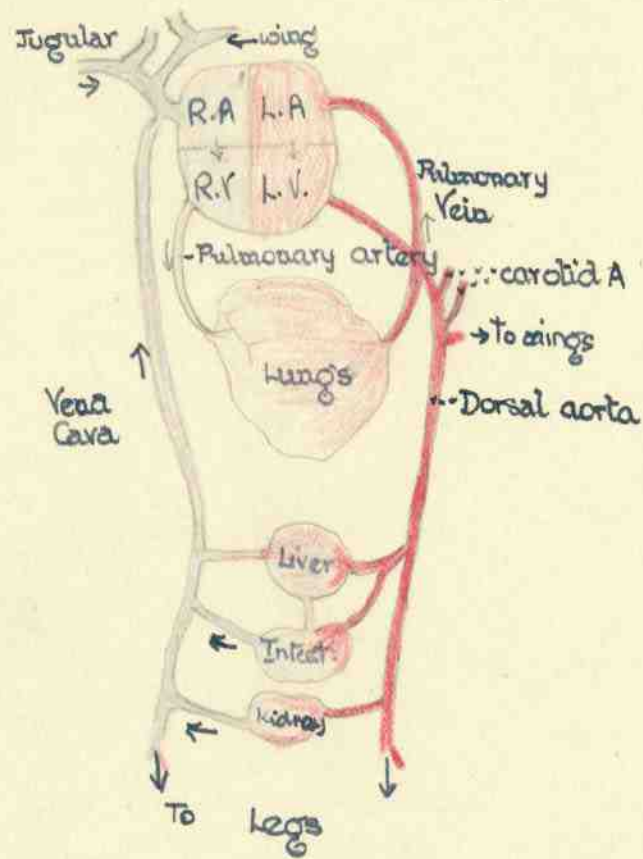
In red corpuscles - haemoglobin - gives off its oxygen  
- can dissolve equal quantity with itself

Blood in the lungs - carbon dioxide

High  $O_2$  tension & low  $CO_2$  tension  $\therefore O_2$  taken in &  $CO_2$  given off.

Near muscles - much  $CO_2$  & low  $O_2$  in blood  $\therefore CO_2$  taken in &  $O_2$  out  
Blood dissolves both  $O_2$  &  $CO_2$  so when either is lacking equilibrium is made.

# Diagram of Circulatory System



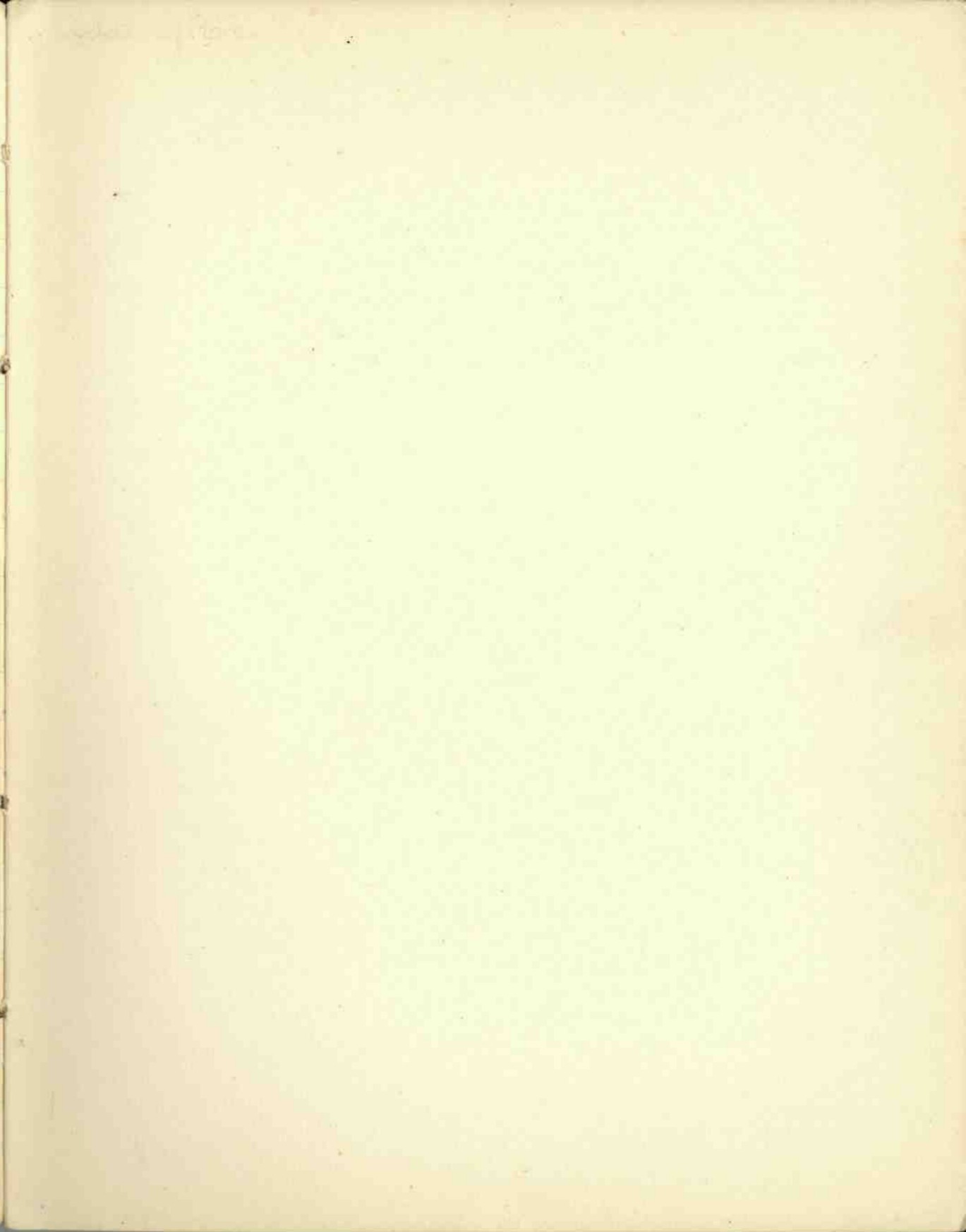
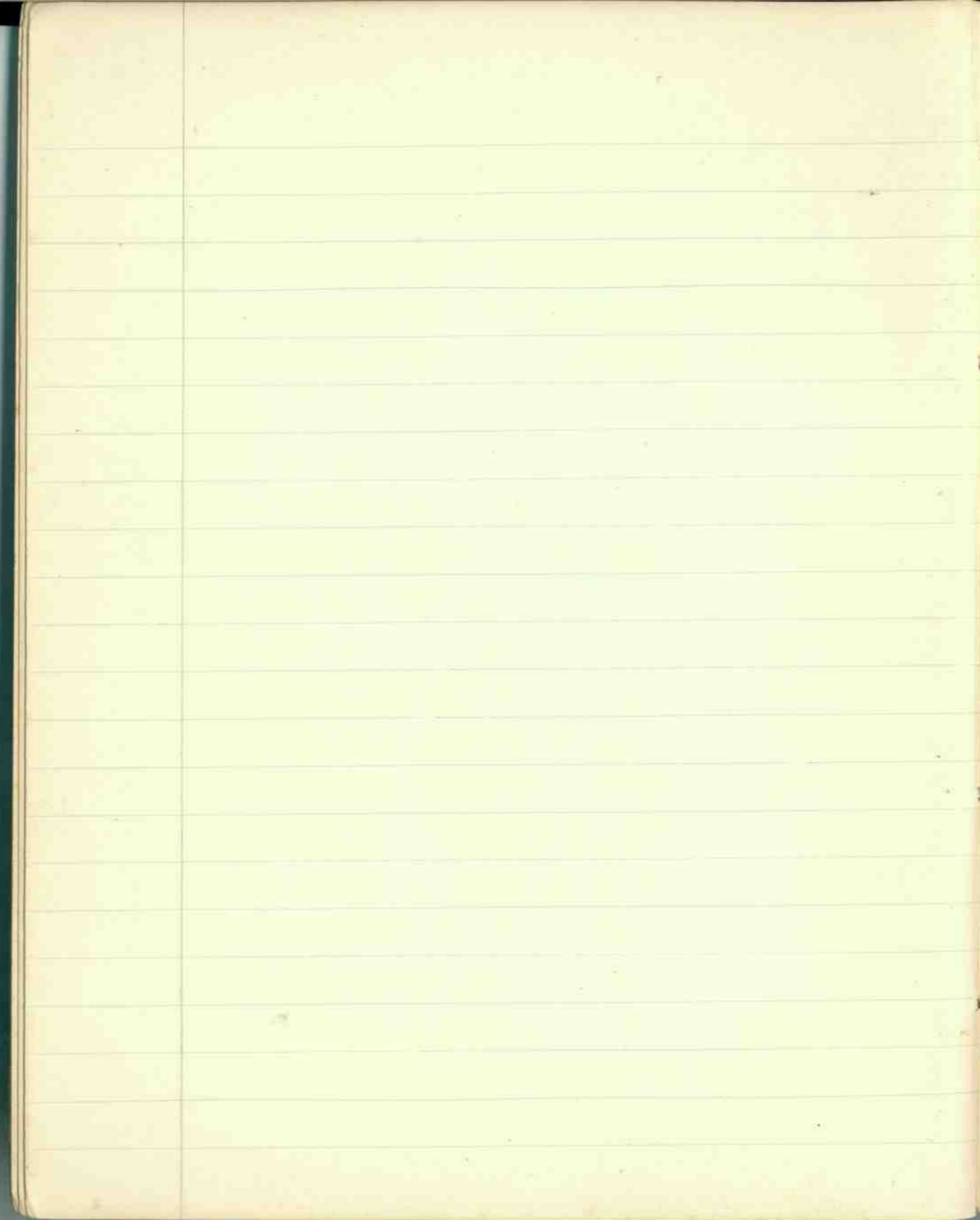
## Chief Uses of Blood.

- ① Gas carrier
- ② Carries product of digestion
- ③ With help of lymph collects nitrogenous waste products
- ④ Distributes products of ductless glands
- ⑤ Contains leucocytes wh. attack bacteria.

## Circulatory System of Pigeon.

- Arterial blood  
 - rich in  $O_2$  poor in  $CO_2$   
 - Venous blood  
 - poor in  $O_2$  rich in  $CO_2$

Veins bring blood to heart - usually contain venous blood.  
 Arteries take " from " - " " arterial



Development of Eggs of Pigeon

(See development of chick from  
egg of hen)

# PARAMOECIUM - Slipper Animalcule.

Protozoa - another primitive animal of Amoeba.

Very active - this is unlike Amoeba wh. are rather sluggish.  
Food down groove into gullet - then goes down into protoplasm + a drop of water.

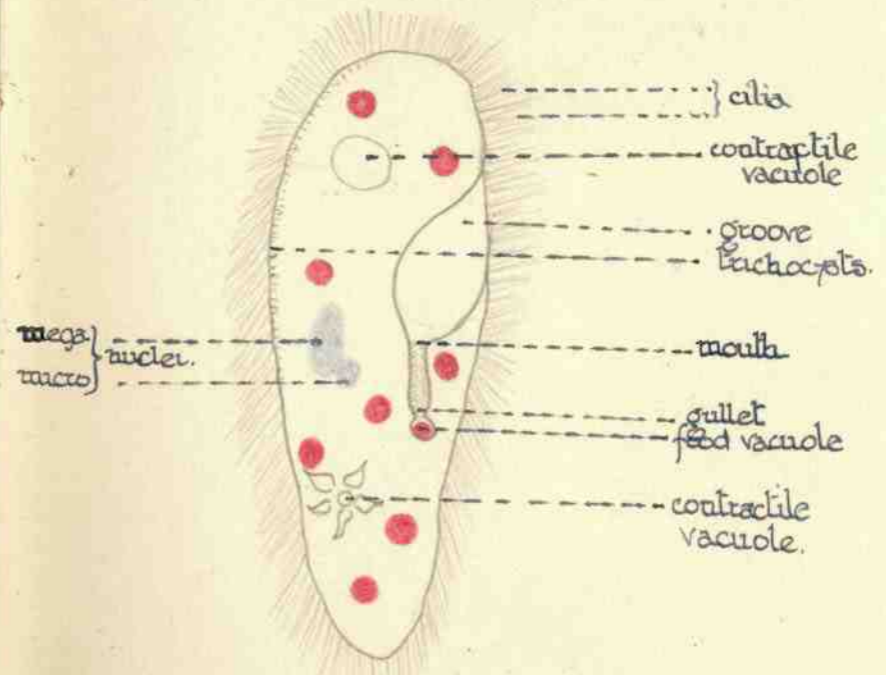
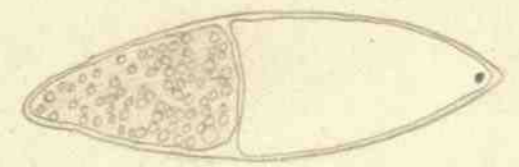
Liquid waste products into canals when passed out of body  
Trichocysts - capable of giving out hairs to stick to other bodies etc.

## Amoeba + Paramoecium.

- ① Locomotion - A has pseudopodia - anywhere - P - cilia
- ② Feeding - A. can swallow anywhere but P. has a mouth
- ③ Nuclei - 2 Nuclei in P. - smaller for reproduction.

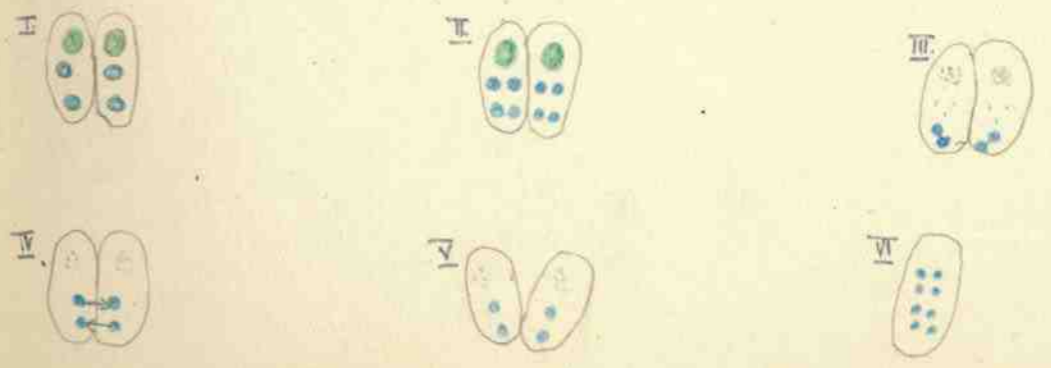
Reproduction ① Each Paramoecium divides into 2 transversely  
- half of ea. nucleus + 1 vacuole to new cells - give out cilia.  
- very frequent reproduction 1 per 24 hrs.

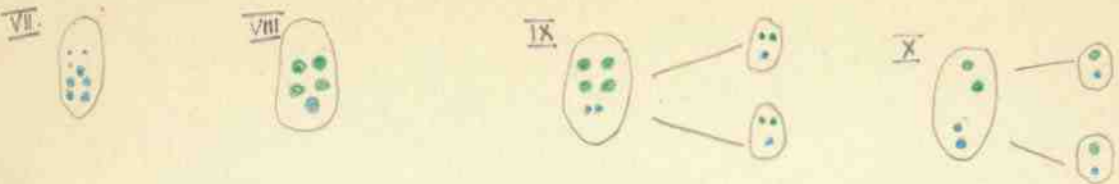
- I. ② Conjugation - 2 approach - mouth cavity less definite  
- join together - mega + micro nuclei in ea. begins to divide into 2 - These again divide
- II Ea. daughter nucleus divides - there are 4 micro nuclei in each cell.
- III Of the 4 nuclei 3 disappear -  
Remaining one in ea. cell divides into 2.  
mega nucleus begins to disappear
- IV The 2 micronuclei in ea. cell - 1 stationary other migratory  
- into other cell - fuses with stationary micronucleus of other cell.  
mega nucleus breaking down
- V The new micronuclei again divide - mega nucleus only a few chromosomes - Paramoecia separate.
- VI The micronucleus in ea. cell divide into 2 - result - 4 micro nuclei in ea. new Paramoecium - then again into 8 micro-nuclei
- VII three micronuclei absorbed
- VIII of the 5 micronuclei four become future mega-nuclei



## Paramoecium

### Reproduction





The fifth remains a micro nuclei.

IX: Micro nucleus divides the cell divides - 2 mega + 1 micro nuclei into each cell.

X: Young cell again divides, <sup>into 2 - micro nucleus again divides.</sup> 1 mega nucleus + 1 micro nucleus passes into each new cell.

What is use of Sexual Reproduction?

Used to be thought that stronger individuals produced by sexual reproduction.

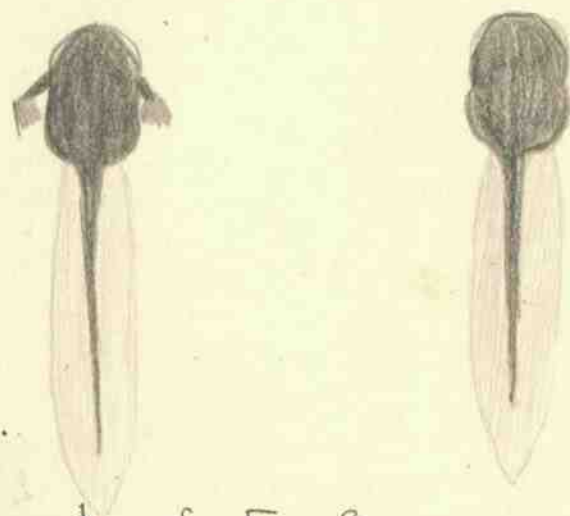
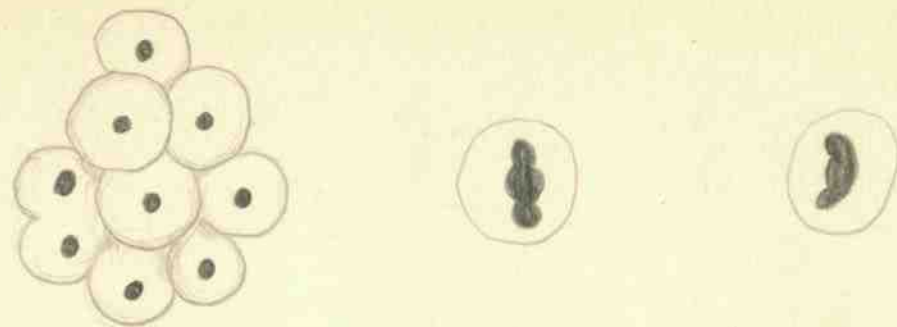


# FROG

## Development of Frog

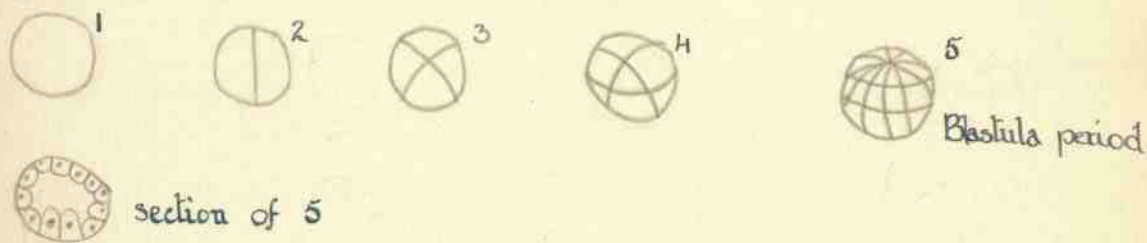
Period I. Single egg - single cell - nucleus in middle - jelly formed after excretion from female - fertilised by male  
Segmentation. - begin to divide + develop - ea. half has a nucleus  
 - divides along meridians then transversely - 2 cells - 4 large + 4 small - small sections form animal - large ones form yolk.  
 further divisions

Period II. Formation of a rough plan.  
 Germ layers.  
 Ectoderm gives rise to the skin - nervous system - sense organs  
 Mesoderm muscles - skeleton - blood system - kidneys +  
 Endoderm . . . . . guts liver pancreas lungs gillblats.

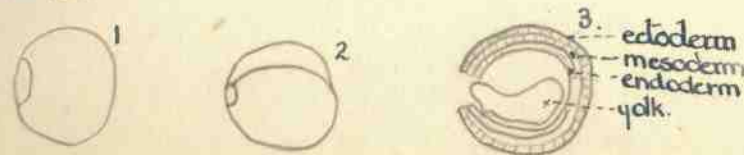


## Development of Frog Spawning

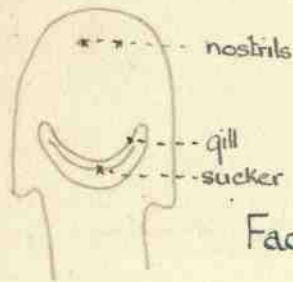
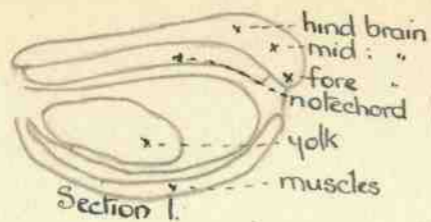
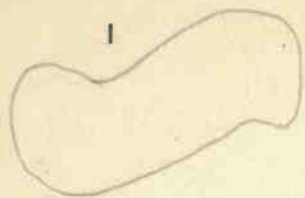
### Period I



### Period II

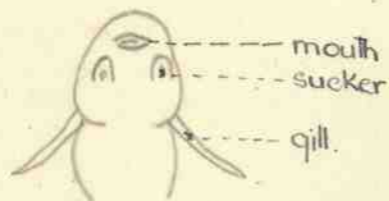


Period III

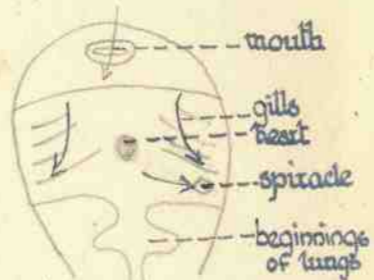
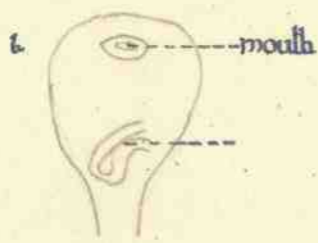
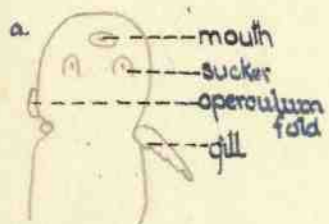


Face View

Period IV

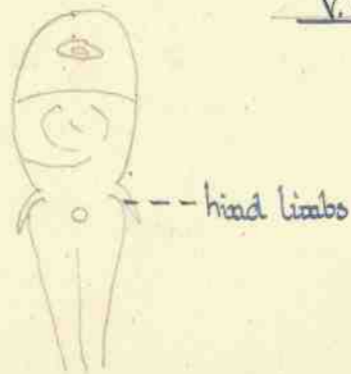
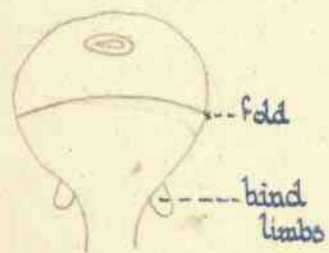


Period V



V.S of (b)

Period VI



Period III - Detailed plan laid down - rapid - lasts 48 hrs as rule.

Rudimentary eyes nostrils present - organism alters shape - all chief organisms present - all cells same kind - can not yet use organisms.

Period IV - Differentiation of tissues

- Gut rudiment capable of digestion  
 - Muscle movement  
 - Nerve tube becomes brain, spinal chord, nerves  
 - Tadpole hatches out as a self supporting organism called a larva

Period V - Commencement of period when animal parts begin to work.  
 - true tadpole stage

Period VI - Tad grows over external gills which are absorbed (atrophy)  
 - four pairs of internal gills are formed in a gill chamber  
 - Water enters the mouth & passes into the gill chamber flowing over the gills. It passes out of an aperture on the left (spiracle)  
 - The opercular folds fuse with the body. The mouth develops horny mandibles & lips have horny teeth. There is a coil intestine. Lungs begin to appear as an outgrowth from the intestine

Period VII - Hind limbs appear - fore limbs grow at same time but obscured by opercular fold

Period VII. Period of metamorphoses - larva to adult - water to land  
Fore legs appear - tail absorbed - gills disappear - lungs are formed - eyes free - movable lids - lacrimal glands are formed (tear glands) - colour of skin changes  
- skull remodelled - horny armature of mouth shed in pieces - lips absorbed - mouth widened - tongue formed  
- intestine shortened - frog leaves water.

#### Changes due to land habit.

- ① Respiration - lungs replace gills & respire thro' skin
- ② Locomotion - legs - cartilaginous skeleton of tadpole replaced by bony skel. of frog.
- ③ Eyes & eyelids & lacrimal glands.

#### Changes due to diff. in diet

- ① Food - vegetarian - adult chiefly on insects ∴ widened mouth & teeth formed - tongue developed - shorter intestines

Period IX Juvenile period - period of growth

Period X Adult - growth slackens - animal sexually mature - longest period of its life - growth & breakdown equally balanced

Period XI Old age - metabolism becomes feebler - organs no longer work well - ∴ natural death ensues.

#### Summary.

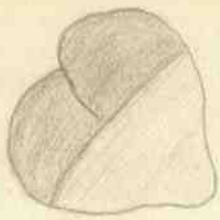
- ① Development - growth & differentiation - increased complexity
- ② Metamorphosis - change of environment <sup>leading to</sup> relatively stable condit.
- ③ Adult - stable condition.
- ④ Loss of stability - death

Period VII





Lung (diseased)



Heart



Liver & Gall Bladder

Enlarged lung - caused by parasitic disease?

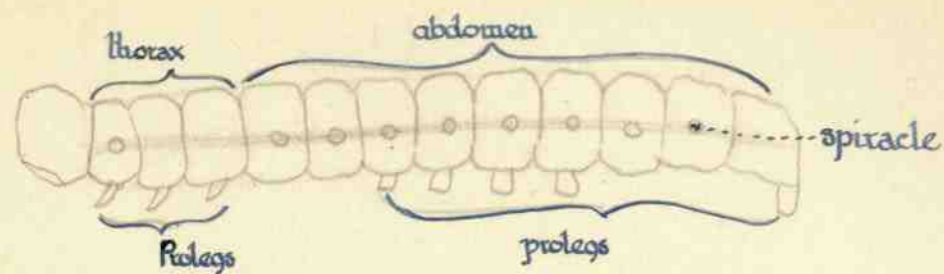
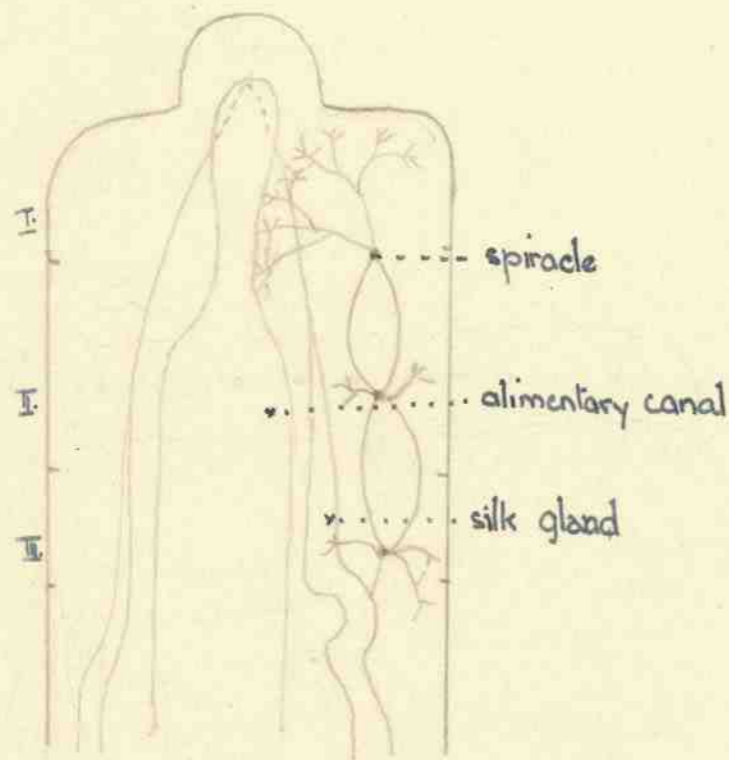


Diagram of Caterpillar



## Large Cabbage White Butterfly.

Caterpillar - 12 segments & a head.

8 pairs of legs - 3 pairs on first 3 segments  
 4 pr of prolegs on segments 6-9 inclusive - 1 pr prolegs  
 on last segment  
 eats most of the time - often doubles its wt in skins

### Ecdysis

This is the time when the caterpillar casts its skin. The skin is made of an elastic substance known as chitin, wh. is a skeleton on the outside. This protects the internal organs.

This skin hinders growth ∴ goes thro' the process of casting its skin known as ecdysis. Coat is airtight & watertight (chitin) ∴ respiration by means of spiracles wh. are connected by branching pipes (of lungs).  
 Periods bet. ecdyses are called instars.

When caterpillars finish feeding they climb upwards - fixed at end & round middle on a wall etc. by means of silk. In few hours they swell above silk girdle & skin splits - draw heads & rest of body gradually through holes.  
 Beginning of pupating period - cabbage white (small) pupate & resemble black ground.

Pupae - Recognise wings - posterior wriggles - spiracles as yellow dots on sides.

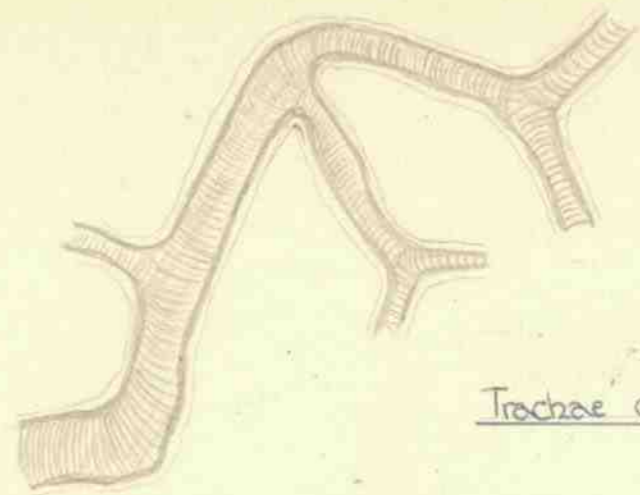
## Life History of a Butterfly (Large Cabbage White.)

Eggs. May. - hatch out August  
Larva & caterpillar - June July Sep. Oct.  
Pupa or chrysalis - July October - April  
Imago or Butterfly - August April  
In summer pupates for only 3-4 wks.  
" winter " " about 6 months.  
Some species spend winter as eggs - larva or butterflies.

### Characteristics of different periods in Metamorphosis.

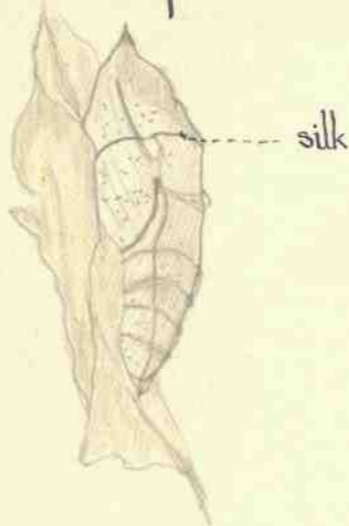
Eggs - rest & development  
Larva - feeding & growth  
Pupa - rest & development  
Butterfly - reproduction & movement

Nectar from flowers is food for butterfly.  
- eggs anything from 6 to 100.



Tracheae of Caterpillar

### Stages in Pupation from rest period

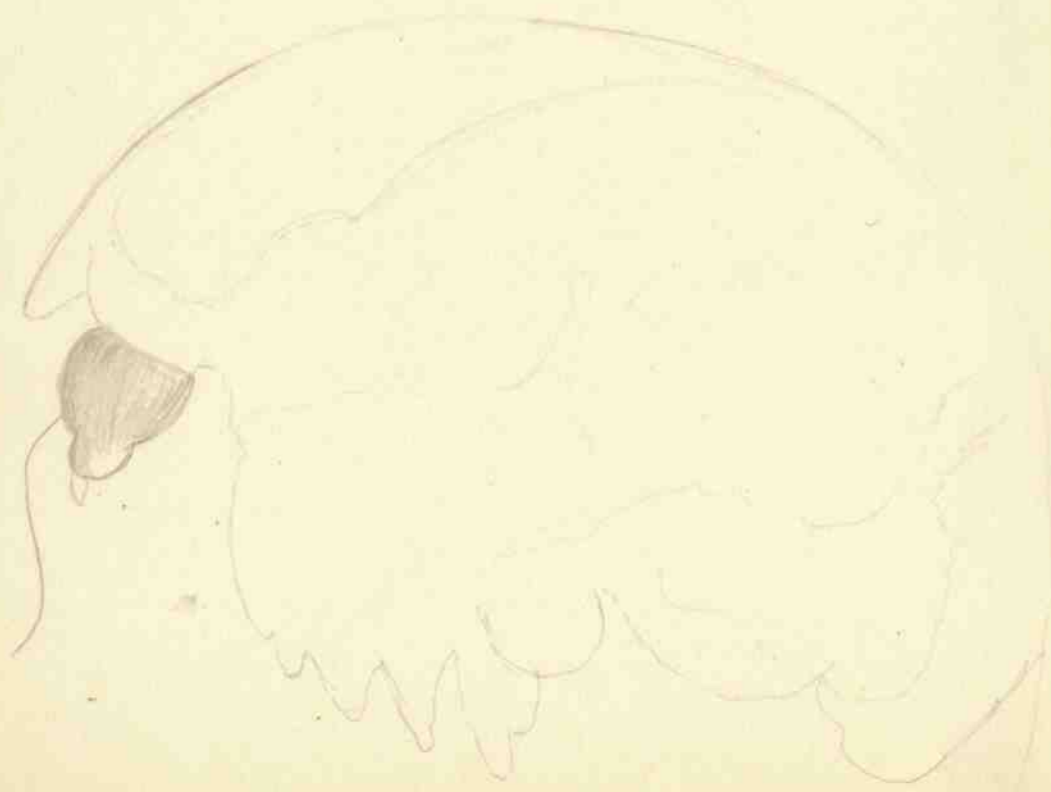
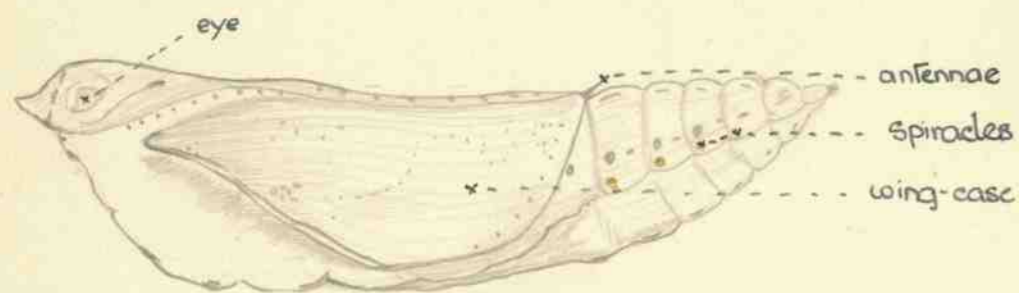


Stage I (N.B. silk-band)



Stage II  
(N.B. Swelling above band)

Stage III      Pupa

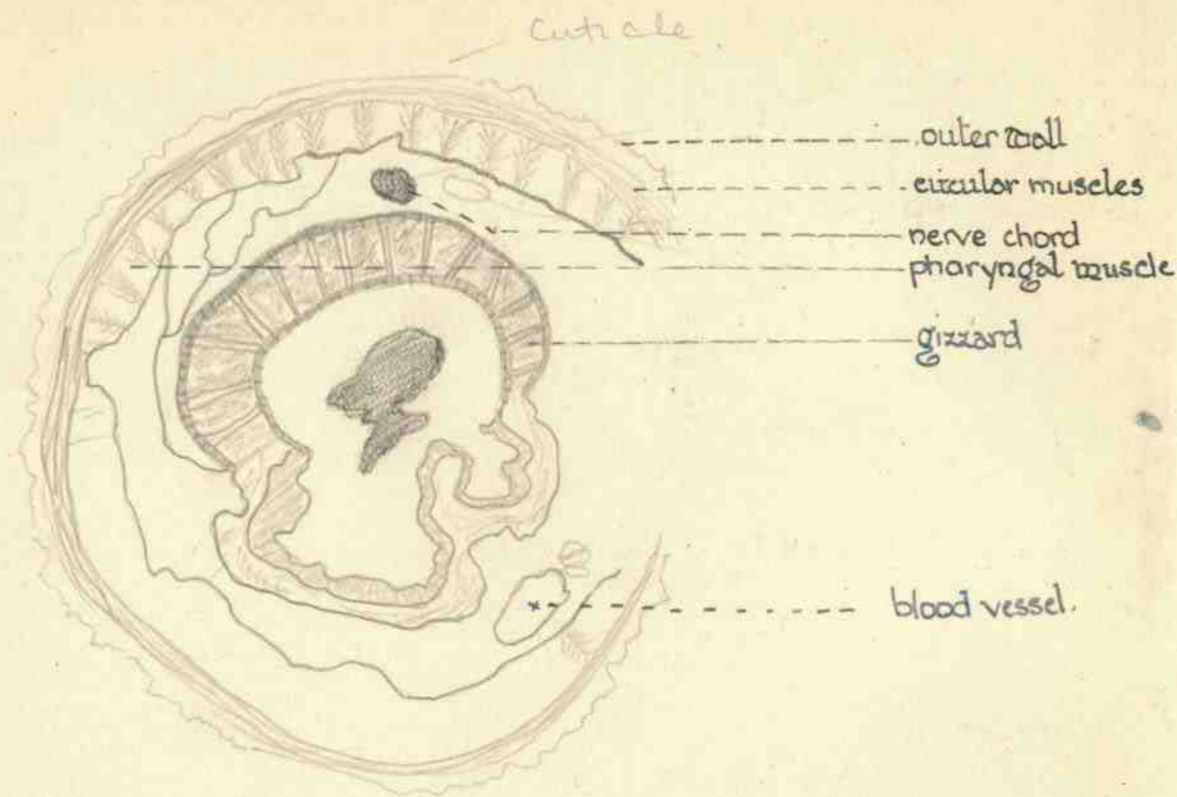


Development from Pupa to Butterfly

Takes place in early spring - changes take place inside pupa-case

Skin splits at back - wiggles head out first  
wiggles out  
limbs wings - pumps air into veins of wing  
stretches membrane of the wing - gradually hardens  
solidifies.

Antennae - sensory organs - may be smell or hearing



T.S. Earthworm (segment 19-20 approx:)

## Earth Worms.

- Annelida

Bodies in segments - have ringed appearance  
 - termed annelida (leeches belong to this section)  
 Peripatus - link between insect and earthworm  
 - Is. near New Zealand - head of insect fused segments.  
 Near relations in ponds and streams - closely allied to earth worms.  
Universal in distribution

Number of species, some large others v. small.

Habits - studied by Darwin "Vegetable Moulds and Earth Worms"  
 Live in burrows lined with slimy substance.  
 If soil crumbly the top is banked with stones and leaves.

Burrowing - done mostly by pushing - anterior conical  
 can easily push two particles of soil.  
 Worm swallows large quantities of soil - no masticatory apparatus ∴ as it eats its way thro' it ejects undigested parts on the surface - earth casts or worm casts.

Darwin found that 10 tons of soil per acre per annum of soil brought up to surface.  
 Later exp. found that it was underestimated rather than over estimated.  
 loose soil - more to surface.

Small cavities formed by burrowing - ventilates soil - often collapses - land sinks  
 This action means burying of surface - archaeological

Seldom leave burrow - tail end usually in burrow.  
 - nocturnal in habits

Artificial Wormery - layers of earth and sand - after a time layers mixed up - boiled cabbage for feeding worms sucks this & thus chags it down into burrow.



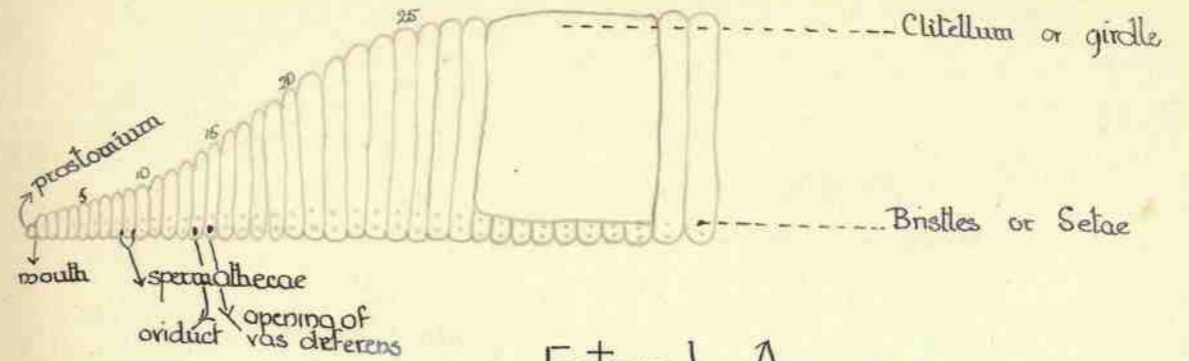
# EARTH WORM

## External Appearance

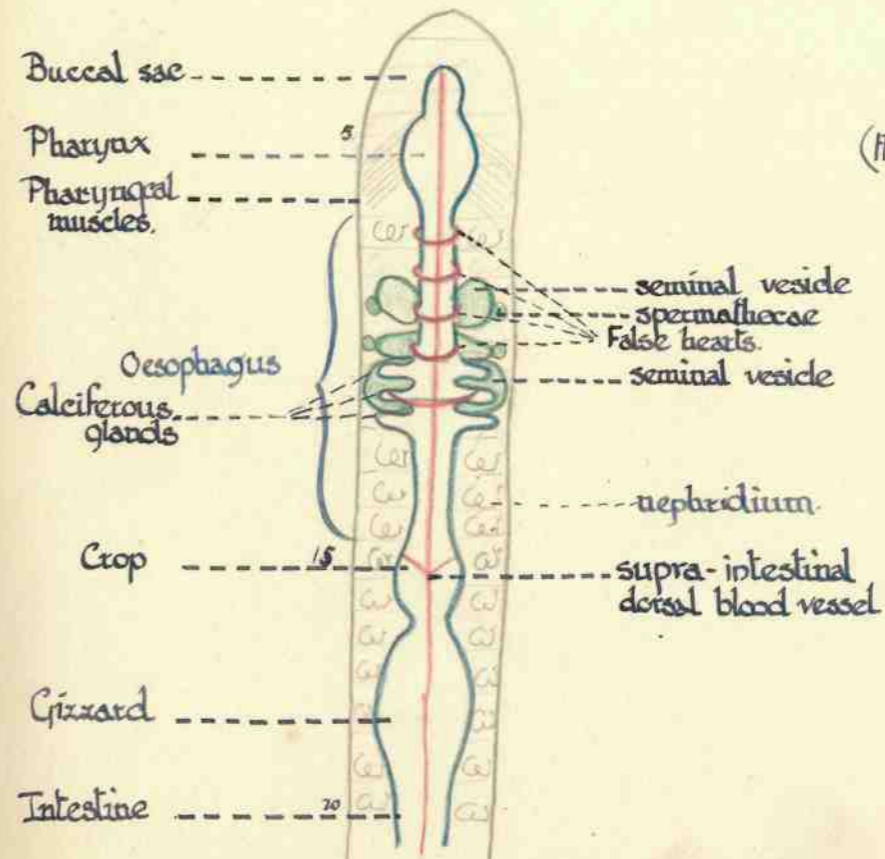
$\frac{1}{3}$  way along the body - swelling - Clitellum or girdle - from here cocoon is produced.

Locomotion - waves of extension & contraction w/ bristles propels body forward - bristles on under side to aid this forward motion  
Dorsal pore on top of ea. segment

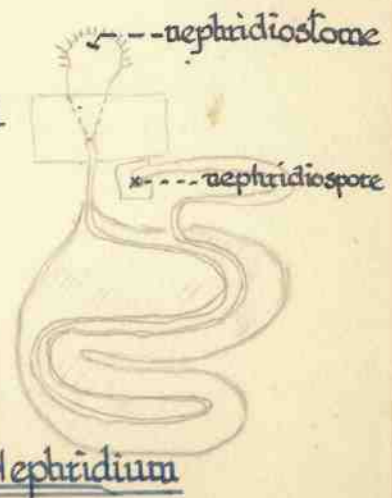
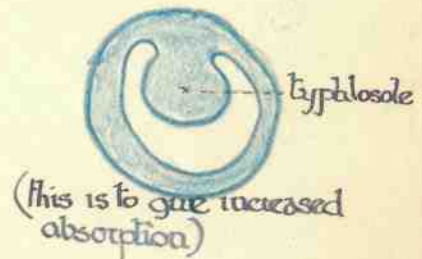
Reproduction - v. complicated  
Hermaphrodite - both eggs & sperms - special devices for cross fertilisation.



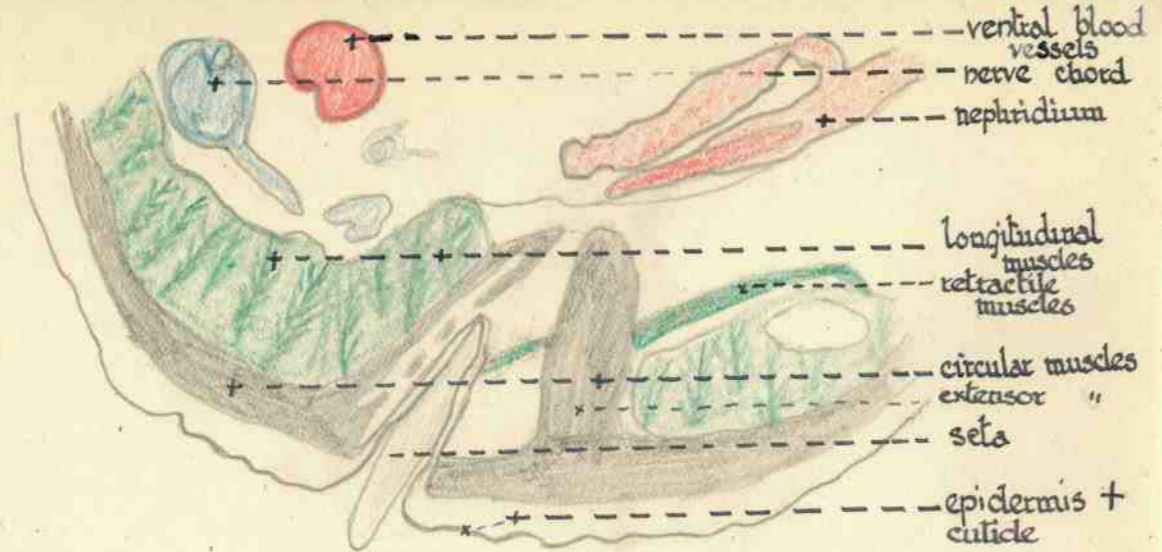
## External Appearance



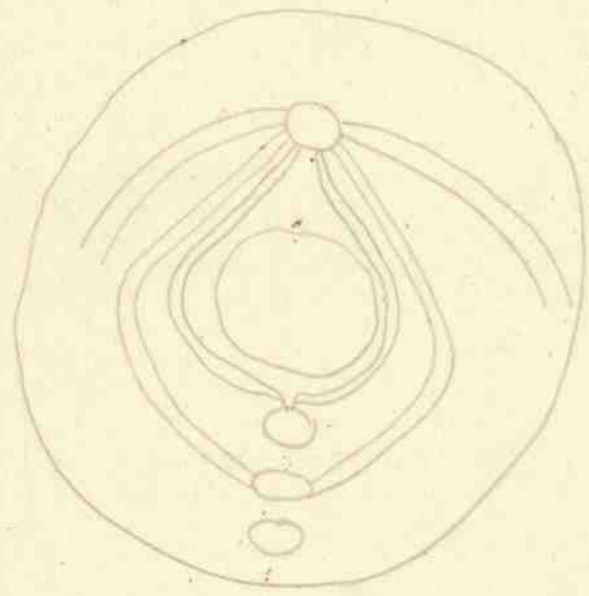
L. Section of Worm (diagram)



Nephridium



T.S. Earth-worm showing seta + muscles governing its movement



Circulatory System.

- ① Gases
- ② Food
- ③ Waste material

Dorsal blood vessel acts similarly to a heart  
 - derives blood supply from near skin (where gases exchanged) - supra-intestinal dorsal b.v. - oxygen loaded  
 Has false hearts - connected with intestine - takes up food & CO<sub>2</sub> charged blood <sup>blood with O<sub>2</sub> from pseudo-heart</sup> - this enters into supra-neural blood vessel - passes into nephridia - loses more oxygen - unites in the subneural vessel - extends to skin & then joins with branches of dorsal supra-intestinal blood vessels.

Exchange of gases from skin.

## Reproductive System of Earthworm

Hermaproditic - possessing both types of reproductive organs  
 Early stages of chick - both sets of organs in rudiments and both develop.  
 Primitive condition - no specialisation.  
Sperms produced by the testis in seminal vesicles  
 testis - pair in 9<sup>th</sup> & pair in 10<sup>th</sup> segments  
 - pass along tubes wh. open in 15<sup>th</sup>

Eggs produced in 13<sup>th</sup> segments - pair of ovaries  
 - funnel & tube opening in 14<sup>th</sup> seg. - cilia action causes them to be washed into 14 segment

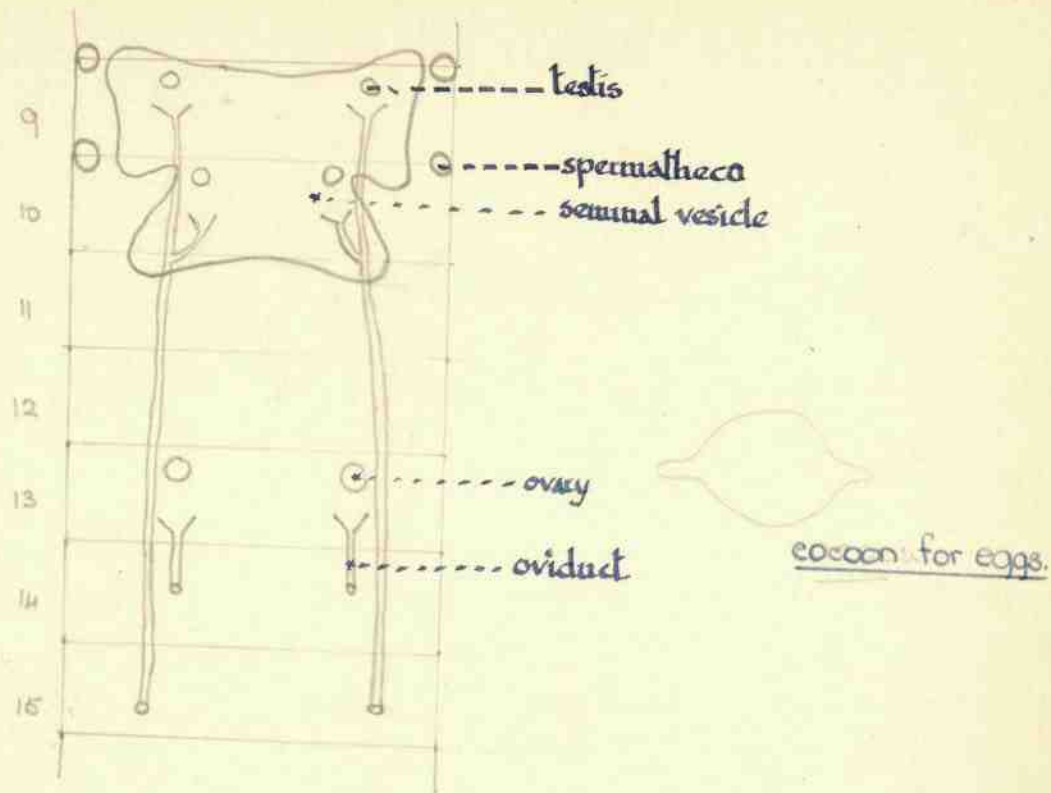
Fertilisation can only take place with sperms from another earthworm. - sperms of other worm must be stored  
 Exchange  $\begin{matrix} \text{eg } 9^{\text{th}} \text{ and } 10^{\text{th}} \\ 10^{\text{th}} \text{ and } 11^{\text{th}} \end{matrix}$  segments - sacs wh. contain foreign sperms - spermathecae

Sperms passing into spermathecae - openings bet. 8 & 9 & 9 & 10

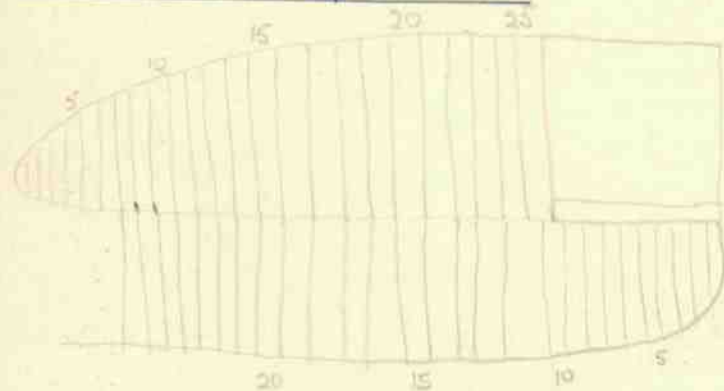
Clitellum produces fluid in both worms - wrapped around both worms - together in pairs  
 Tube formed by muscular contraction - exchange of sperms - worms separated again

Egg laying - clitellum - secretion hardens - forms sheath - passes along - eggs in sheath - passes on till gets to foreign sperms - worm wiggles out of sheath - ends come together & lemon shaped cocoon is formed

## Earthworm cont:



## Conditions for Reproduction



## Nervous System

Chord giving off branches

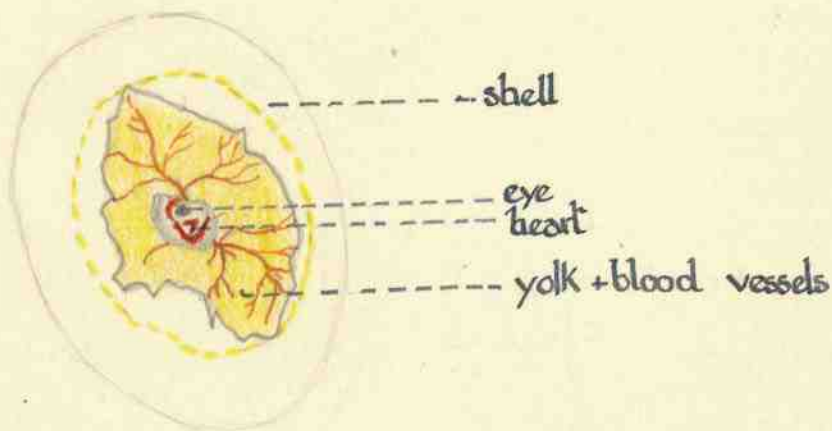
In head - divides into 2 - on either side of alimentary canal forms bunch of nerves - ganglion - into branches  
- brain of this animal

Feb 8

# Development of Chick (a young bird.)



3 days

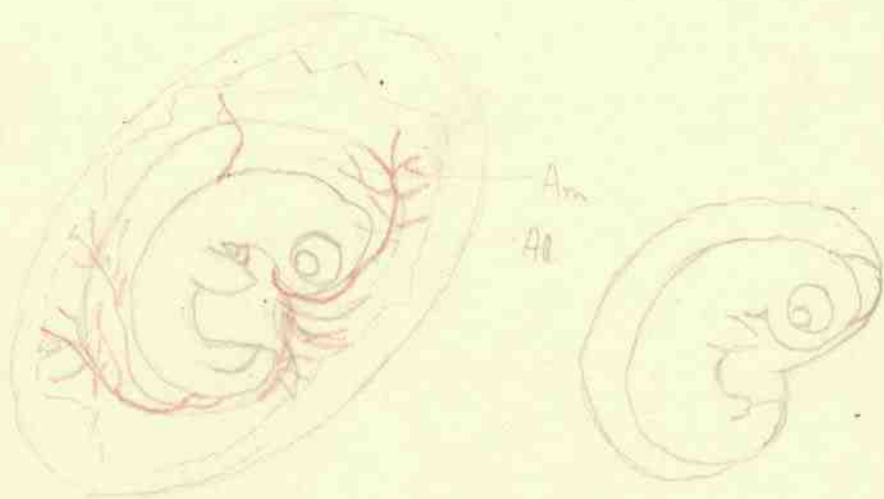


4 days

5 days



6 days



7 days



DAPHNIA - water flea - in ponds lakes.

transparent under microscope - physiologically important

External skeleton but not an insect  
① no. of legs  
② no trans formations  
③ no wings.

Crustaceans - arthropoda ① insects  
② crustacea

Real animal is in outer shell - 2 halves opening down centre.  
Body proper is substance enclosed in intestine.

Antennae. Attached to head end - 2 pairs of limb-like structures to help in speed of swimming. They are really primordial antennae

Eye. Second antennae are merely vestiges  
Daphnia begins life with 2 eyes - fuse together.  
Eye fixed by nerve chords or optic nerves to the brain - not muscular.  
Eye moves about.

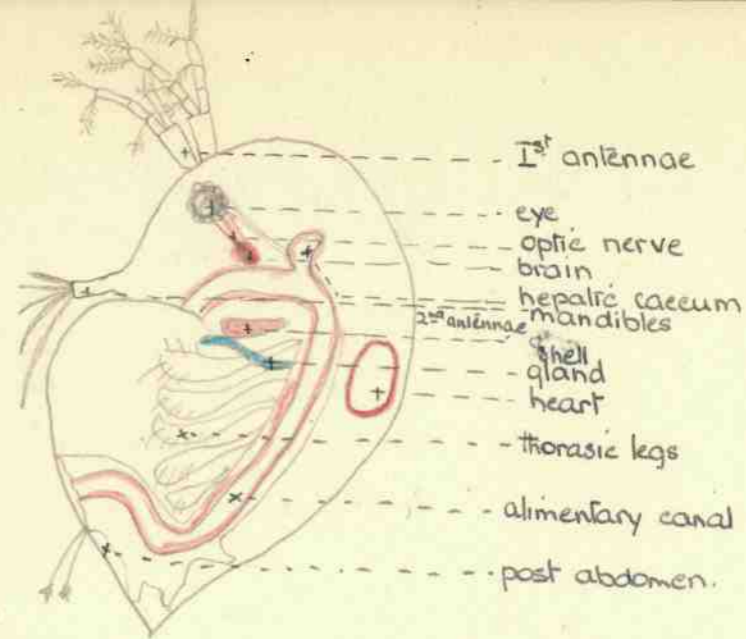
Heart and Intestine. Intestine begins near mouth - gland hepatic caecum - similar but not a liver  
Heart can be seen pulsating - corpuscles enter side of heart and are driven out by the front-valve in heart must be true to cause circulation of blood.

Blood patch - unfertilised eggs develop young are passed out of body.

Postabdomen

Locomotion By the 1<sup>st</sup> antennae & thoracic legs

Nutrition Microscopic organisms - algae; bacteria etc.  
Obtains food by filtering apparatus - on thoracic legs - formed into pellet of food - guided into mandibles by maxillae - passes into mouth thence into alimentary canal



Daphnia

Circulation - no definite blood-vessels - passes along series of passages.  
Heart lies in cavity - takes blood in by slit at side  
↳ forced forward by pulsation.

Respiration - no special organs - legs may be able to supply the oxygen - also inside of system.

Excretion Shell gland functions as a kidney ↳ gets rid of nitrogenous waste.

### Sight and other sense organs.

There is eye present ∴ some sort of sight  
Smell - 2<sup>nd</sup> antennae function in that way.  
Touch - hairs on post abdomen

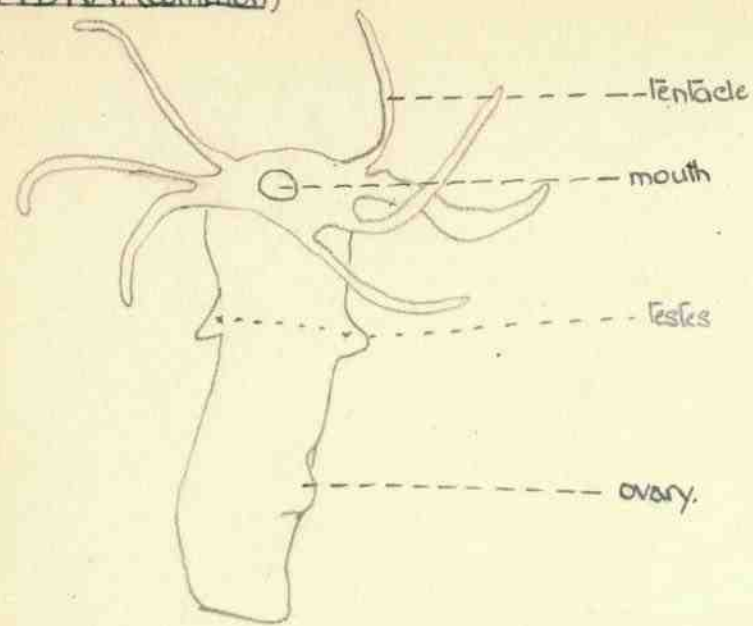
### Reproduction

May - nearly all female daphnia.  
Eggs pass into blood patch - develop without being fertilised - when large enough they are passed out.  
Later in the year males are found -  
When males are present - eggs are fertilised - fewer in number ↳ different from unfertilised eggs  
Chitinous body enclosed the 2 fertilised eggs  
(ie) Ephippium encloses ephippial eggs. - withstand drought.  
Unfertilised eggs are in the Parthenogenesis ↳ are called parthenogenetic eggs

Queen-fly - early spring - all females until last batch - males too - last throughout winter (no queen fly; only the fertilised eggs)



# HYDRA (common)



# HYDRA

- Animal - occurring in ponds & ditches - sometimes in slowly moving streams but most usual in stagnant waters.

Body - hollow tube - narrowed to mouth wh. can open & close - surrounded by 8-10 tentacles.  
No external skeleton - body v. flexible.

Inside tube is enteron or digestive organs - waste matter returns thro' mouth.  
Mouth end is distal region  
Attached - proxima

## Types.

① Common hydra - ② Brown hydra - ③ Green hydra (green coloring matter due to symbiotic alga - zoochlorella)

Body divided into 2 layers divided by thin mesoglea

- ① Ectoderm - outer skin
- ② Endoderm - inner

A. Ectoderm -

- ① epithelial cells from wh. others evolve
- ② interstitial cells - repairers & help to form reproductive organs
- ③ nematocyst - stinging apparatus - complex thread coiled inside - from this there is bristle or ciliodril protruding.

If this comes in contact with prey the nematocyst is discharged and the thread is shot out - liquid is forced along - penetrates animal even through chitin & paralyzes the prey - chiefly developed on the tentacles

Bundles of muscles & nerves

B. Mesoglea - between layer.

C. Endoderm - to digest food - some produce secretion wh. can digest protoplasm - pepsin in type absorbed by endodermal cells.  
Pseudopodia protrude into hollow tube & hold the fragments of food

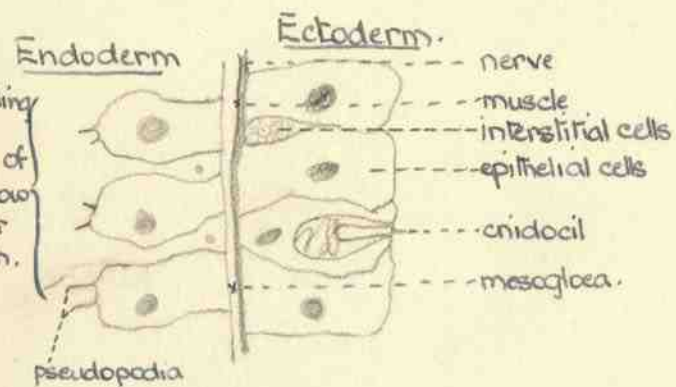


Diagram of Section of hydra.

## Response to stimuli

<u>Touch.</u>	Body & tentacles contract
<u>Light</u>	Attracted & sensitive to light - phototactic
<u>Chemicals.</u>	Explosion of nematocysts
<u>Food.</u>	Mouth & endodermal cells respond to food

## Locomotion.

1. Series of loping movements.
2. Proximal cells give out mucus to cement itself
3. Walking on tentacles.

## Nutrition

Small crustacea - insect larvae - water mites  
- eats things larger than itself.  
Catches prey by tentacles - to mouth - hydra bulges  
digestion by endodermal cells - waste is ejected  
through the mouth.

## Respiration

no specialised organs - uses oxygen from water

Reproduction

- ① Broodson side - grows tentacles - becomes detached
- ② Lumps on sides
- ③ testes wh. produce spermatozooids
- ④ ovary " " " " oocytes

Testis bursts - spermatozooids enter ovary - fuse and produce egg cells wh. survive the winter.

Coelomata {  
Bird. -  
Frog. -  
Insect. -  
Daphnia -  
Earthworm -  
                    - Nemes

Acoelomata {  
Hydra - Coelenterata - multicellular  
                    specialised cell functions  
Euglena }  
Paramecium } Protozoa - unicellular  
Amoeba }

A 1. The essential qualities of the living organism as illustrated by its growth, irritability, movement, reproduction.

2. The structure in suff. detail only to elucidate the above functions

Types suggested

I Algae ✓

Protococcus ✓

Chlamydomonas

Marine Algal plankton + bearing on food of fish

Spyrogyra ✓

Vaucheria ✓

II Fungi + Bacteria ✓

Parasitic + saprophytic forms ✓

III Lichens mosses ferns gymnosperms

Angiosperms.

IV Amoeba ✓

Paramecium ✓

Euglena ✓

Hydra

Earthworm ✓

Daphnia ✓

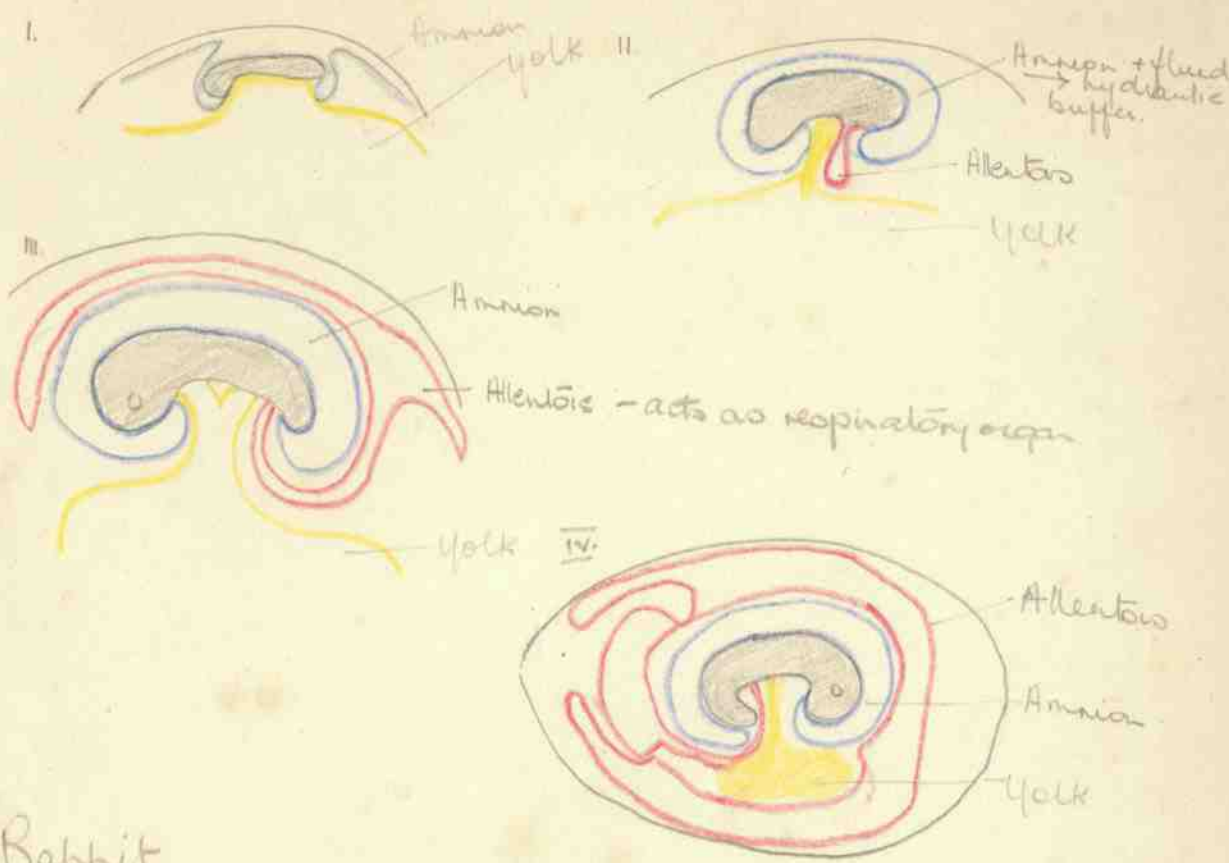
Insect - Frog Bird

B Outline of the history of devel. of Evolution Ideas  
Elementary facts of evolution + genetics ✓

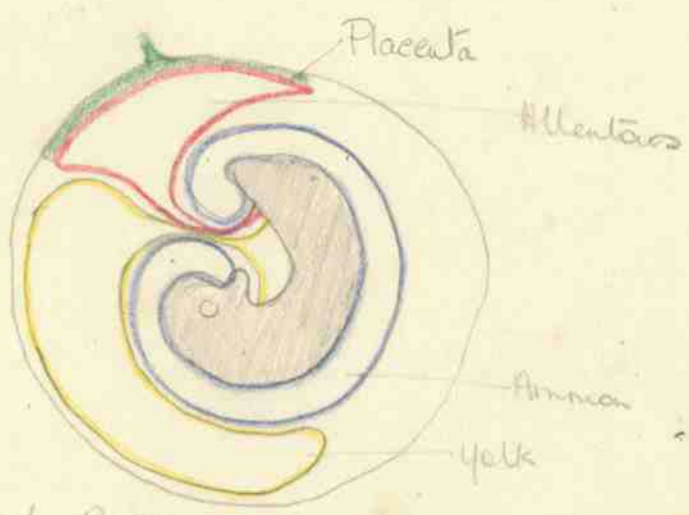
C Field work with a view to studying the relationship of organisms to their environments + the life history of some of the commoner animals + plants. ✓

D Thesis (re. Individual Research)

Chick



Rabbit



Embryo of Rabbit